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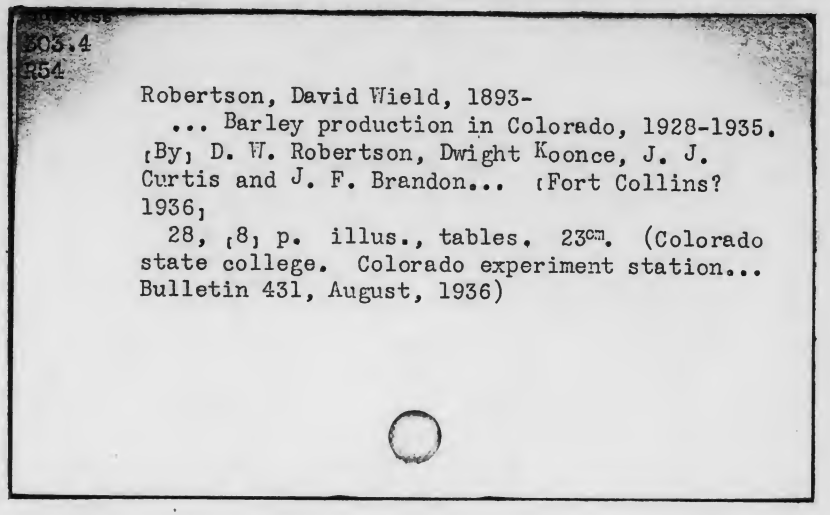

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Robertson, D.W.

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Barley production
in Colorado.

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1928-1935.

Bulletin 431 August 1936

Barley Production in Colorado 1928 - 1935

D. W. ROBERTSON, DWIGHT KOONCE
J. J. CURTIS AND J. F. BRANDON

Field of Trebi Foundation Seed on Agronomy Farm, Colorado Experiment Station, Fort Collins

Colorado State College
Colorado Experiment Station
Fort Collins

SUMMARY

IN COLORADO annually about 154,550[1] acres of barley are grown on irrigated land and 385,051 acres under dryland conditions. Of the total area sown to barley in the state 28.6 percent is on irrigated land and 71.4 percent on dry land. The average yield for the 5-year period 1928 to 1934[1] is 39.8 bushels per acre on irrigated land and 13.3 bushels per acre on dry land.

IRRIGATED CONDITIONS

The climate of Colorado in most of the agricultural areas is suitable for the production of barley. A crop of excellent bushel weight (48 pounds) and high quality can be produced in most of the irrigated sections. East of the mountains a high protein barley is produced suitable for feed but not in demand by the eastern brewing industry. At the higher altitudes where the season is cooler it may be possible to produce a barley which lacks the hard, steely kernel typical of the high-protein barleys grown east of the mountains.

From tests of barley varieties grown at Fort Collins the following recommendations are made: The highest-yielding six-rowed barley is Trebi. The highest-yielding brewing barleys are Wisconsin Pedigree 38 and Velvet. They yield about 15 percent less than Trebi and are smooth awned and six-rowed.

Hannchen was the highest-yielding two-rowed barley tested. Most two-rowed barleys shatter more than the recommended six-rowed barleys, thus losing a higher percentage of grain in harvesting.

Colsess, a stiff-strawed, six-rowed, hooded barley, is still recommended on irrigated farms as a nurse crop for alfalfa and red clover, and for hay production on mountain ranches or on plains irrigated farms.

Several new hybrids show promise and are being tested further in farmers' fields.

At Fort Lewis, at an altitude of 7,610 feet, Trebi is the highest-yielding barley tested for the entire 7-year period. Several smooth-awned hybrids show promise but should be tested further before they should be recommended for general use.

Colsess was the highest-yielding hooded barley and is recommended for a nurse crop for alfalfa at the higher altitudes.

For conditions similar to those of Fort Lewis the highest yields of barley are obtained when the seed is sown before May 15. The rate of seeding is about 95 pounds per acre.

[1]Colorado Year Book, 1929, 1930, 1931, 1932, 1934.

DRYLAND CONDITIONS

At Akron the earlier-maturing blue-green foliage types have produced the most favorable yields. Late-maturing varieties, as a rule, do not yield well under dryland conditions in eastern Colorado. Club Mariout and Flynn are the highest-yielding varieties which have been tested for a period of 8 years or longer.

Vance Smyrna, a two-rowed barley which shows some resistance to smut, is the best-yielding two-rowed barley which has been tested for an 8-year period or longer.

Several new introductions show promise but cannot yet be recommended for general use.

THRESHING

On both the irrigated and dry land great care should be taken in threshing barley. This is particularly true with barley which goes onto the market for malting purposes. Skinned and broken kernels are a hazard to the maltster, and any chance of receiving a premium for the crop can be ruined in the threshing.

BARLEY UNDER IRRIGATION

On the heavier lands, if soil-moisture conditions are good, fall plowing should be practiced. If the soil is dry in the fall, plowing had best be put off until spring. If the spring grain follows beets or potatoes, any fall plowing necessarily will be late. Spring plowing should be done as early as possible. The plow should be followed immediately by the disk or harrow. The land should be leveled prior to seeding. The object of leveling is to produce a surface of uniform grade in order to assist in the even distribution of water. The usual rate of seeding for barley on irrigated land is 2 bushels per acre.

In the northern Colorado districts it is seldom necessary to "irrigate up" small grains. In the Arkansas Valley, often in the San Luis Valley, and in some western slope localities natural precipitation is so uncertain that it is necessary to "irrigate up." On the tighter soils where it is necessary to irrigate crops up the land should be irrigated, then disked, leveled, harrowed, and planted as soon as possible. The better practice on light sandy soils is to plant first and then irrigate, since sandy lands dry out at the surface quickly.

In the Arkansas Valley, and in other districts where furrow irrigation is practiced, the crop is planted, furrowed, and irrigated. If there is moisture enough in the soil to keep the crop growing, irrigation is not necessary until about the time the crop commences to head. The crop should not be allowed to suffer for water, even if

it is necessary to irrigate prior to heading. On the tighter lands in northern Colorado one irrigation for small grains is usually sufficient. On the sandier land two or more irrigations distributed through the growing season may be necessary to produce the same results. In those sections where it is necessary to irrigate crops up two irrigations on the tighter lands or three irrigations on the sandier lands are usually sufficient to produce a crop. If the crop is growing rather vigorously, showing no need of water, the heaviest grain production can be obtained by irrigating when the plants are heading. If barley has sufficient moisture to insure vigorous growth until heading time, then one good irrigation with the normal rainfall will insure a crop on the tighter lands of northern Colorado. Very little is gained by irrigating after the grain is in the milk, and often losses are caused by delayed ripening and lodging.

DRYLAND BARLEY

Barley is one of the most certain crops for feed purposes grown on the plains. Barley does well on a seedbed prepared by disking and harrowing corn stubble. A slightly higher yield is obtained from growing barley on summer fallow. Unless the precipitation is low this method does not pay for the extra cost of fallowing and the loss of a crop. In some localities fall listing, where the previous crop will permit such treatment, and working the listing down in the spring to a seedbed, has been found as successful and cheaper than fall plowing. Results at Akron show little difference between fall and spring plowing as a preparation for barley. However, the fact that the destruction of weeds in the fall conserves moisture should be remembered. Therefore some fall treatment may be of benefit in areas where the precipitation is low. Lands likely to blow, if covered with a good stubble, should not be fall worked. The stubble is protection from wind damage.

RECOMMENDED VARIETIES

For conditions similar to those at Fort Collins (irrigated):
- Six-rowed barley—Trebi, Colsess.
- Two-rowed barley—Hannchen.
- Brewing barley—Wisconsin Pedigree No. 38 (smooth awn), Velvet (smooth awn).

For conditions similar to those at Fort Lewis (high-altitude irrigated):
- Six-rowed barley—Trebi, Colsess.

For conditions similar to those at Akron (dryland):
- Six-rowed barley—Club Mariout, Flynn.
- Two-rowed barley—Vance Smyrna.

Barley Production in Colorado 1928-1935

BY D. W. ROBERTSON, DWIGHT KOONCE, J. J. CURTIS, AND J. F. BRANDON

THE barley-growing sections of Colorado may be divided into two general areas—the irrigated and non-irrigated. An average of about 154,500 acres are grown on irrigated land, and 385,000 acres are grown under dryland conditions. The barley acreage is approximately 28.6 percent on irrigated land and 71.4 percent on dry land. The average yield for the 5-year period 1928 to 1934 is 39.8 bushels per acre on irrigated land and 13.3 bushels on dry land.

The five counties producing the largest amount of barley[2] are Weld, Logan, Washington, Kit Carson, and Larimer.

CLIMATE

The climate of Colorado in most of the agricultural areas is suitable for the production of barley. Barley of excellent bushel weight and high quality can be produced in most of the irrigated sections. On the dry land Club Mariout, Flynn, and Coast yield well, but only in exceptional years do they produce barley of high bushel weight. Under Colorado conditions east of the mountains a high protein barley is produced suitable for feed, but it is not in demand by the eastern brewing industry. At the higher altitudes, where the season is cooler, it may be possible to produce a barley which lacks the hard, steely kernel typical of the high-protein barleys common east of the mountains. Further experimental work is necessary before final conclusions can be reached on this point.

LOCATION OF EXPERIMENTAL FARMS

There are three station farms in Colorado where barley varieties have been tested for the 8-year period 1928 to 1935, inclusive. The central station is located at Fort Collins, in the north central part of the state. At this station variety tests are carried under irrigation. The type of soil, elevation, and climatic conditions make it fairly representative of the irrigated sections in the northeastern part of the state.

The Fort Lewis farm is located in the southwestern section of the state, in La Plata County. The elevation of the station is 7,610 feet. At this station grains are tested under irrigation. The elevation and climate make this station a desirable place to test grains for high-altitude conditions.

[2]Colorado Year Book, 1929, 1930, 1931, 1932, 1934.

The United States Dryland Field Station, located at Akron, Colo., is operated in cooperation with the U. S. Department of Agriculture. This station is located in the heart of the plains section of Colorado. Tests conducted at this station are under dryland conditions.

TESTS UNDER IRRIGATION AT FORT COLLINS

The climate at Fort Collins tends to produce a high-protein barley. The dry, hot weather often found in July and August has a tendency to ripen the grain prematurely and to produce hard, steely kernels. A longer ripening period and a cooler climate tend to produce a more mealy kernel, which is desired by the brewing industry.

The winter months are mild but sufficiently severe to make the production of winter barley unprofitable. Tests conducted at Fort Collins from 1910 to 1917, inclusive, clearly demonstrated that winter barley is not adapted to northern Colorado conditions.

Treatment of Plats

The barley tests are sown on summer fallow to insure clean land and uniform moisture conditions. While this treatment gives yields slightly higher than those found under average farm conditions, the results obtained are comparable.

Irrigation

Average climatic conditions at Fort Collins allow the accumulation of sufficient moisture in the winter and early spring to bring a barley crop to the jointing stage without irrigation. Under normal conditions a single irrigation at this stage will produce a good crop. Barley, however, should be kept growing normally in the early stages of growth, since lack of moisture while the plants are in the early boot stage will reduce the size of the heads, even if sufficient water is applied later. If two irrigations are necessary, one should be applied at the tillering and the other at the heading stage. In lighter soils more irrigations may be necessary. However, too late an irrigation may cause the crop to lodge.

Care of Grain

The threshed grain from each plat is cleaned and weighed. The yield data are determined from the cleaned grain weight. The standard errors are calculated by the variance method.[3] Ten plats of each variety are grown, and the yields are the average of these ten plats. These plats are scattered at random in each series so that a random sample of the soil variability may be obtained for each variety.

[3]Fisher, R. S., Statistical Methods for Research Workers, 4th ed.

TABLE 1—*Monthly, annual, and seasonal precipitation at Fort Collins Station from 1928 to 1935, inclusive*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal*
1928	0.26	0.52	1.38	1.02	3.01	2.95	0.79	0.27	0.09	1.50	1.15	0.06	13.00	9.15
1929	0.21	0.70	1.78	2.37	1.08	0.64	0.46	2.35	2.13	0.99	0.93	0.09	13.73	6.33
1930	0.45	0.07	0.70	0.58	3.92	1.50	1.04	5.88	0.16	0.36	0.70	0.14	15.50	7.74
1931	0.00	1.26	0.41	1.07	2.94	1.46	0.05	0.75	0.51	1.00	0.63	0.18	10.26	5.93
1932	0.08	0.48	1.09	0.71	2.65	1.26	2.08	3.29	0.01	0.34	0.34	0.49	12.82	7.79
1933	0.16	0.13	0.60	1.91	4.47	0.01	1.12	5.31	1.97	0.00	0.06	1.06	16.80	8.11
1934	0.01	1.11	0.71	1.42	1.96	0.95	1.13	0.27	0.53	0.00	0.06	T	8.15	6.17
1935	0.07	0.89	0.21	1.35	6.36	0.63	1.14	0.35	3.36	0.62	0.66	0.00	15.64	9.69
Average	0.16	0.64	0.86	1.30	3.30	1.18	0.98	2.31	1.09	0.60	0.57	0.25	13.24	7.61
41-year average up to 1927**	0.35	0.60	1.06	2.16	2.81	1.57	1.81	1.24	1.30	1.19	0.46	0.51	15.06	...

*Seasonal—March to July, inclusive.
The rainfall records for the months of January, February, March, October, November and December are obtained from R. E. Trimble.
The rainfall records for the other months are obtained from the rain gauge on the Agronomy Farm, about one mile east of the Official U. S. Weather Station located on the main college campus.

**R. E. Trimble, The Climate of Colorado, Colo. Exp. Sta. Bul. 340.

Time and Rate of Seeding

Spring barley is planted from April 1 to April 20. Earlier plantings may be injured by frost. Good results, however, have been obtained from later plantings. The usual rate of seeding is 95 pounds per acre for hulled barley and 90 pounds per acre for hulless barley.

Rainfall

Table 1 gives the rainfall for the years 1928 to 1935, inclusive. The average rainfall for the months of January, March, April, June, July, September, October, and December is below the 41-year average ending in 1927. The average rainfall for the 8-year period is 13.24 inches. The average rainfall for the 41-year period ending in 1927 was 15.06 inches. The seasons of 1928, 1929, 1931, 1932, and 1934 were all low. The total rainfall for each year was: 13.00 inches in 1928, 13.73 inches in 1929, 10.26 inches in 1931, 12.82 inches in 1932, and 8.15 inches in 1934.

Disease

The following extract is taken from U. S. Department of Agriculture Farmers' Bulletin 1732, "Growing Barley for Malt and Feed," by H. V. Harlan:

"Covered smut is the most widely distributed of the important diseases of barley. The total loss due to it is considerable. The percentage of infection varies enormously with season and region. Where covered smut is common, clean seed should be used where possible. If clean seed is not at hand, the farmer should resort to dust treatment. One of the mercury dusts is a logical choice, not only because of its usefulness in treating smut but also because of its effect on scab and stripe, where these are present. All three diseases can be controlled by a single treatment, insofar as seed treatment is effective. The mercury dusts are also effective in treating one form of loose smut. The other forms can be controlled by the hot-water treatment. Because of the serious seed injury that may result, the hot-water treatment is not recommended for use by farmers."

All the previously-mentioned diseases, with the exception of scab, are more or less common on the various barleys tested at the station.

The following directions for treatment are given in U. S. D. A. Miscellaneous Publication 199, "Barley Diseases," by R. W. Leukel and V. F. Tapke:

COVERED SMUT

In barley affected with covered smut, smutted heads appear about a week after heading time. Frequently they are borne on short stalks and do not fully emerge from the boot. The smut mass is hard, difficult to rub off, and remains intact until broken in threshing.

Control.—Treat seed with an effective organic mercury dust, formaldehyde dust, or formaldehyde solution.

BROWN LOOSE SMUT AND BLACK LOOSE SMUT

Heads affected with brown or black loose smut are readily observed only at heading time. The smut mass is powdery and easily rubbed off. Soon after heading, the smut is blown or washed away, leaving only the bare central stalk of the head (rachis). The brown and the black loose smuts are very similar in appearance and difficult to distinguish. The former is olive brown. The latter is dark chocolate brown, almost black in color.

Control.—For brown loose smut treat the seed with hot water. For black loose smut treat the seed with an effective organic mercury dust or formaldehyde solution.

STRIPE

Shortly before heading time, long yellow-to-brown stripes appear in the leaves. Later the leaves may become shredded by splitting along these stripes. Affected plants usually are stunted. The head usually does not emerge fully from the boot, is discolored and shrunken, and rarely produces sound kernels. By harvest time the diseased plants have died and are hard to find.

Control.—Treat seed with an effective organic mercury dust.

DUST TREATMENTS

Formaldehyde dust.—There are several brands of formaldehyde dust on the market. They contain from 4 to 8 percent of formaldehyde by weight. Formaldehyde dust controls covered smut only, although it may partly control other diseases. The cost of the dust may vary from 3 to 6 cents per bushel of seed. It is applied at the rate of 3 ounces per bushel in a rotary seed treater or by the shovel method. After treatment the grain should be stored in sacks or in a covered pile for not less than 1 nor more than 5 days.

Organic mercury dusts.—One of the commercial organic mercury dusts has been found to control covered smut, black loose smut, stripe, and seedling blight, and is recommended for barley-seed treatment. (Consult your county agricultural agent for further information.) It costs about 2 cents for each bushel of seed. It is applied at the rate of only one-half ounce per bushel either by means of a rotary seed treater or by the shovel method. After treatment the grain should be stored in sacks or in a covered pile for not less than 1 nor more than 10 days.

LIQUID FORMALDEHYDE TREATMENT

Liquid formaldehyde treatment controls covered smut and the black loose smut and reduces seedling blight due to infected seed. Occasionally it causes some injury to germination, especially when not properly applied, when sowing is delayed too long after treatment, or when the seed is sown in dry soil. For these reasons dust treatments are to be preferred, although the materials may cost somewhat more. Liquid formaldehyde costs about 1 cent for each bushel of seed treated, but its application is more laborious and disagreeable, and it is less effective in disease control than dust treatments.

First clean the seed thoroughly and put it in loosely woven burlap or gunny sacks half filled and tied at the top. Mix 1 pint of commercial formaldehyde in 40 gallons of water in a tub, tank, or barrel. Immerse the half-filled sacks of grain in this solution for 1 hour. Then let them drain a few minutes, and spread out the grain in a thin layer on a clean floor or canvas to dry. Stir it occasionally to hasten drying. Sow as soon as it is dry enough to flow readily through the drill. Make allowance for its swollen condition by setting the drill to sow about one-fourth more per acre. If sowing is delayed it is important that the treated seed be thoroughly dried to prevent injury.

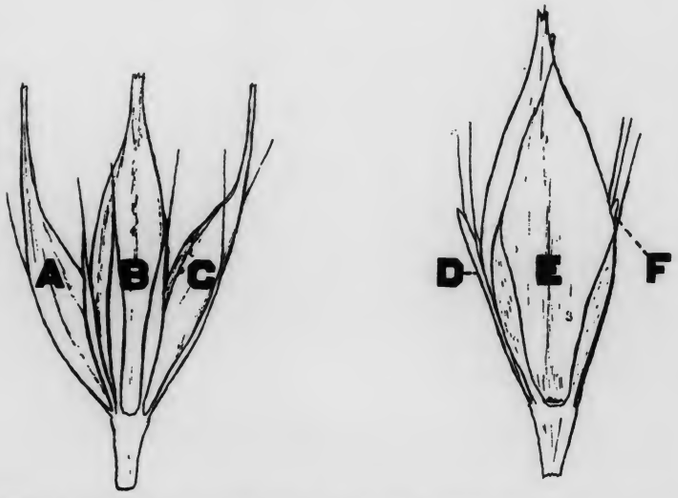

Figure 1.—Six-row and two-row barley: *A, B,* and *C,* fertile spikelets on a single node of the rachis of six-rowed barley; *E,* fertile spikelet; *D* and *F,* infertile spikelets on a single node of the rachis of two-rowed barley.

Experimental Results

Barley Variety Tests

The detailed results of the tests at Fort Collins are shown in table 1, Appendix. Forty-two varieties or strains were tested for varying periods of years since the last published data, Bulletin 371, which included the tests made up to the end of 1927. Of these varieties only 17 now remain in the test. The others have been dropped for low yield or some other undesirable character. Of the 17 remaining varieties Trebi is still the highest yielder for the 8 years of the test 1928 to 1935, inclusive. Ezond, a smooth-awned variety, has yielded well. Of the varieties recommended for malting purposes, Wisconsin Pedigree 38 and Velvet are the best yielders.

Figure 2.—Grain of Colsess, showing hood.

Several new hybrids produced at the station show promise. These are smooth-awned hybrids (Coast x Lion). One of these, F. C. 1110, has an average yield equal to that of Trebi for the 4-year period it has been tested. Two others, F. C. 1108 and 1109, yielded slightly lower, but the difference was small and not significant. The highest-yielding hybrid is being tested in cooperation with the Extension Service on farmers' fields. It is also being tested for malting quality. This barley shows promise as a smooth-awned, stiff-strawed variety on irrigated land. It, however, is slightly susceptible to smut and should be treated before sowing.

Six-rowed Barley.—Under irrigation in Colorado six-rowed barleys are most commonly grown. This type of barley has three single-flowered spikelets at each node of the rachis, which are fertile (fig. 1—*A, B, C*). This arrangement of florets produces a head of spike with six rows of florets, three on each side of the rachis. The common six-rowed barleys have either of two types of appendages to the lemma; i. e., awns or hoods (fig. 2). The awned barleys have a long appendage extending from the tip of the lemma. The awn may be either barbed or smooth (figs. 3 and 4). Trebi is a typical example of a rough-awned barley. Velvet is considered as one of the smooth-awned types, and Colsess[4] is a typical example of hooded barley.

[4]Robertson, D. W., and Kezer, Alvin, Colsess Barley, Colo. Exp. Sta. Bul. 303.

Trebi is the highest-yielding barley at Fort Collins. For brewing, Wisconsin Pedigree 38 and Velvet are recommended. They yield about 15 percent less than Trebi. Colsess is the highest-yielding hooded barley.

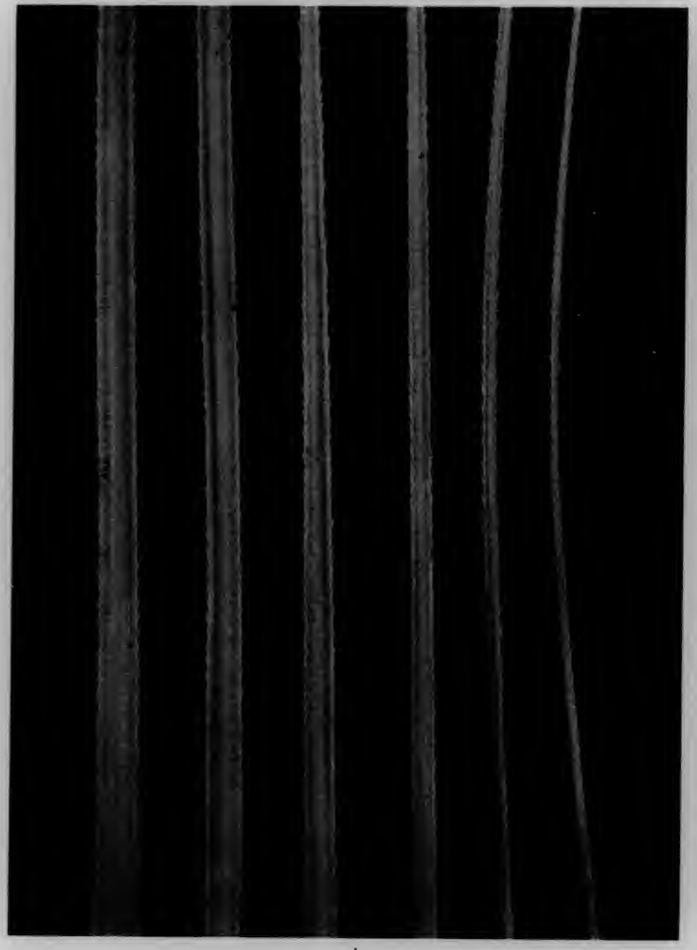

Figure 3.—Awn of rough-awned barley; notice the rough, saw-like, barbed awn found on varieties such as Trebi and Club Mariout.

Two-rowed Barley.—Two-rowed barleys differ from six-rowed barleys, since only the middle one of the three florets on each joint of the rachis is fertile and produces seed (fig. 1—*D, E, F*). The two-rowed commercial barleys are awned.

Hannchen, C. I. No. 531, outyielded Spartan, C. I. No. 5027, a

Figure 4.—Awn of smooth-awned barley. Notice the absence of barbs on these awns. On the smooth-awned barleys only a small section of the awn at the tip is rough. Wisconsin Pedigree No. 38, Velvet, and Flynn are smooth-awned barleys.

smooth-awned, two-rowed barley, 4 years out of 6 and is recommended where a two-rowed barley is desired on irrigated land. Many two-rowed barleys shatter badly during harvest.

Hulless Barleys.—Hulless barleys differ from hulled barley by having the grain free of the hull (lemma and palea). Of the hulless barleys tested Nepal has given the best yield under irrigation. However, the yield is not sufficient to encourage the production of hulless barleys.

Agronomic Data

The summary of the agronomic data for Fort Collins is given in table 2, Appendix. Only data on the varieties in the test in 1935 are presented. All the varieties mature in about the same number of days. The straw length varies slightly, but none of the varieties can be classed as short strawed. Several varieties have weak straw. The varieties with stiff straw are Colsess, Velvet, Coast x Lion, F. C. 1110 and 1108, Trebi x Colsess, and F. C. 1124 and 1125.

The disease-infection data are rather interesting and indicate some resistance in some of the varieties tested. Coast 23, Velvet, Colsess, Elfry, Coast x Lion, and F. C. 1110 and 1109, are susceptible to stripe disease *(Helminthosporium gramineum)*. Trebi also shows lack of resistance to this disease. Ezond, Hannchen, and Wisconsin Pedigree 38 show some resistance under field conditions. Several varieties are more susceptible than the others to smut.[5] Elfry, Colsess, and Coast x Lion seem to be the most susceptible. Trebi, Ezond, and Velvet seem to show some resistance. The data, however, emphasize the fact that all the varieties should be treated before sowing.

Summary

From the tests of barley varieties grown at Fort Collins the following recommendations can be made. The highest yielding six-rowed barleys are Trebi, Ezond, and Coast x Lion, F. C. 1110. The latter two are smooth-awned. The highest-yielding brewing barleys are Wisconsin Pedigree 38 and Velvet. They yield about 15 percent less than Trebi under Fort Collins conditions.

Colsess, a stiff-strawed, hooded barley, is still recommended as a nurse crop for alfalfa and red clover.

Nepal is well adapted to conditions found at Fort Collins, and if a hulless barley is desired, it may be grown. It yields about 35 percent less than Trebi and is weak strawed and lodges badly.

Hannchen is the highest-yielding two-rowed barley. Most two-rowed barleys shatter more than the recommended six-rowed barleys, thus losing a higher percentage of grain in harvesting.

All varieties should be treated for disase (smut and stripe) before sowing.

[5]No distinction is made between loose and covered smut.

Figure 5.—Field of Colsess barley at Fort Collins.

EXPERIMENTS AT FORT LEWIS

DWIGHT KOONCE

The Fort Lewis farm is located in the San Juan Basin, in the southwestern part of the state. The farm is conducted in cooperation with the Fort Lewis School of the Colorado State College of Agriculture and Mechanic Arts, at Hesperus. The school lands are about 5 miles south of Hesperus. The experimental farm occupies bench land of the La Plata River. The land slopes to the southeast toward the river. The soil is a dark loam underlaid by gravel at a depth of 2 to 15 feet. The slope of the land is rather steep, which causes some difficulty in irrigation. Small heads of water must be used. The furrow method of irrigation is necessary for both grain and rowed crops.

TABLE 2—*Frost-free period at Fort Lewis, 1923-35*

Year	Date of last killing frost	Date of first killing frost	Frost-free period
1923	June 20	September 19	91
1924	June 19	September 12	85
1925	June 12	September 14	94
1926	May 14	September 29	136
1927	June 3	September 28	117
1928	May 18	September 14	119
1929	May 29	September 9	103
1930	June 1	September 23	114
1931	May 31	September 21	113
1932	June 8	September 10	94
1933	June 7	October 15	130
1934	June 7	September 26	111
1935	June 1	September 29	120
13-year average, 1923-1935	June 3	September 21	110

Climatic Conditions

The season opens late in the spring, due to the higher altitude and the fact that a heavy covering of snow usually falls in winter. The normal frost-free period is between 100 and 120 days. Table 2 gives the dates of the last killing frost in the spring, the first killing frost in the fall, and the frost-free period for the years 1923 to 1935, inclusive. The average date of the last killing frost in the spring is June 3. The average date of the first killing frost in the fall is September 21. This gives an average growing season of about 110 days. The dates of the killing frosts were taken when actual damage by frost occurred to tender plants, and not on the dates when the thermometer registered 32 degrees. This practice gives a longer frost-free period than would be obtained if the thermometer readings of 32 degrees were used.

Precipitation

The average annual rainfall is about 18 inches (tab. 3). The rainfall of May and June is usually low. About 40 percent of the annual precipitation occurs in July, August, and September, and there is considerable snowfall in the winter months which, under normal conditions, leaves sufficient moisture in the soil to carry spring grain crops to the first of June, when the first irrigation is usually applied. The heavy winter snows sometimes retard the planting date in the spring.

Treatment of Plats

Barley is planted on fall-plowed land following field peas. Each variety was grown in 10 small plats which were distributed at random. The yields given in table 3, Appendix, are the averages of the cleaned grain from the 10 plats. The average date of planting is about April 20th. Two or three irrigations were necessary, due to the shallow soil and low precipitation in June.

Experimental Results

Table 3, Appendix, gives the yields of barley at Fort Lewis under irrigation. Trebi is the highest-yielding barley tested for a 7-year period. Several hybrids, however, show promise. Several Coast x Lion selections yield higher than Trebi for the period in which they have been tested. These varieties are being increased for farmers' tests before final recommendations are made. These selections are stiff-strawed and smooth-awned. Of the brewing barleys Wisconsin Pedigree 38 and Velvet are the highest yielders in the test but yield about 15 percent less than Trebi. Colsess is the highest-yielding hooded barley, yielding about 17 percent lower than Trebi.

Agronomic Data

Most of the barley varieties matured the first part of August. Chevalier II, a two-rowed, very weak-strawed variety, was the latest

TABLE 3—*Monthly, seasonal, and annual precipitation in inches at Fort Lewis Station, 1928 to 1935, inclusive*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal*
1928	0.51	1.70	1.53	0.37	1.26	0.02	2.12	1.51	0.63	2.97	2.89	1.14	16.65	5.30
1929	1.24	1.74	0.95	1.21	0.68	0.00	4.13	3.91	3.34	1.19	0.20	0.18	18.77	6.97
1930	2.61	0.74	1.15	1.31	0.89	0.35	2.76	3.08	0.50	0.32	1.91	T	15.62	6.46
1931	0.15	2.45	1.03	1.82	0.50	2.03	3.20	1.14	2.22	2.09	3.64	2.35	22.62	8.58
1932	0.74	3.23	0.98	1.22	0.84	0.83	2.97	4.05	1.30	1.56	T	1.81	19.53	6.84
1933	1.66	1.32	0.60	1.88	0.72	0.66	1.82	1.98	2.51	1.21	0.82	1.40	16.58	5.68
1934	0.19	2.03	0.08	0.81	1.16	0.25	1.63	1.75	1.50	0.31	1.74	1.24	12.69	3.93
1935	2.11	2.31	3.25	1.48	3.49	T	1.16	2.38	2.57	1.69	1.12	0.67	22.23	9.38
Average	1.15	1.94	1.20	1.26	1.19	0.52	2.47	2.48	1.82	1.42	1.64	1.10	18.09	6.64
15-year average 1921-35	0.85	1.51	1.39	1.24	1.07	0.68	2.37	2.49	2.03	1.25	1.18	1.34	17.40	6.68

*Seasonal—March to July, inclusive.

TABLE 4—*Yield in bushels per acre for date of planting studies made at Fort Lewis for the 5-year period, 1931-1935, inclusive*

Variety	Date planted	Yield in bushels per acre					Average	5-year average Date ripe	5-year average Days to mature
		1931	1932	1933	1934	1935			
Trebi	April 15	81.0	94.0	70.1	69.9	100.5	83.1	8/2	106
	May 1	87.5	88.4	69.5	72.5	90.0	81.6	8/7	98
	May 15	93.6	79.0	77.4	55.9	73.6	75.9	8/19	95
	June 1	109.9	68.8	77.1	36.4	55.8	69.6	9/4	95
	June 15	67.8	61.8	52.6	24.5	32.9	47.9	9/16	93
Colsess	April 15	78.0	76.0	49.6	50.0	82.0	67.1	8/2	105
	May 1	61.5	76.0	59.9	65.6	70.9	67.4	8/6	97
	May 15	73.5	62.4	59.3	50.4	62.9	61.8	8/17	93
	June 1	73.0	54.8	61.5	36.6	49.5	55.1	9/3	93
	June 15	80.5	58.9	45.3	15.9	27.5	45.6	9/15	92
Level of significance		39.0	27.0	25.0	19.0	27.0	12.6		

to mature. The strength of straw is rated according to stiffness. An absolutely stiff-strawed variety would be designated as 100 and a variety incapable of standing up as 0. The different grades of stiffness are indicated in percentage. Colsess is the stiffest-strawed variety in the test, rating 91 percent. Trebi may be considered weak strawed, rating 64 percent. Velvet is very weak, rating 47 percent. Of the varieties tested for shorter periods Coast x Lion F. C. 1110 is the stiffest. Only one of the Coast x Lion crosses, F. C. 1118, may

Figure 6.—Barley field at Fort Lewis.

be considered at all weak. The variation in straw length is slight, all the varieties being taller than 30 inches.

Trebi (bearded six-row) and Colsess (hooded six-row) were planted in triplicate plats at 15-day intervals from April 15 to June 15 during the 5-year period 1931 to 1935. The results are similar for the two varieties (tab. 4). The first three plantings produced good yields. The first two plantings matured on about the same date, and the average yield was almost identical. The average date of maturity for the June 15 planting was September 15. This planting, however, produced the lowest yield. The results of this date of planting test indicate that barley should be planted by May 15. Plantings as late as June 15 will mature, but the yields are lower.

Summary

From the variety test studies made at Fort Lewis for the 7-year period, 1928 to 1935, the following recommendations can be made:

Trebi is the highest-yielding barley tested for the entire period. Several smooth-awned hybrids show promise and should be further tested on farms. Colsess is the highest-yielding hooded barley.

For conditions similar to those of Fort Lewis, the highest yields of barley are obtained when the seed is sown before May 15, but barley will mature when planted as late as June 15.

EXPERIMENTS AT AKRON ON DRY LAND[6]

BY J. J. CURTIS, J. F. BRANDON, AND D. W. ROBERTSON[7]

Barley is equal in importance to any spring-sown cereal grown on Colorado dry land. In the dryland districts barley is used almost exclusively as a feed crop and is mostly fed on the farms where grown. As a result its market value is usually a matter of minor importance, the total amount of feed produced being the important consideration. Barley at Akron matures slightly earlier than other spring cereals. In many seasons the earliest varieties mature fully as early as winter wheat. The early maturity of the crop often enables it to escape droughts which injure other crops seriously.

The experiments at Akron are conducted wholly on dry land. The data obtained should be generally applicable, not only to nearly all dryland sections of eastern Colorado but to adjacent portions of western Kansas, southwestern Nebraska, and southern Wyoming.

This bulletin reports the results of the barley varietal experiments conducted in the last 8 years. Earlier experiments are reported in Bulletin 371 of the Colorado Experiment Station.

Location and Description of Station

The Akron Field Station is located about 4½ miles east of Akron, the county seat of Washington County. The station, containing about 400 acres, is located 112 miles northeast of Denver on the main line of the Chicago, Burlington and Quincy Railroad. The topography of the station is slightly rolling. The soil is a naturally fertile, sandy loam known locally as "hard land." The soil of this section is variable in texture but comparatively free from coarse gravel.

Climate

The climatic conditions at Akron are similar to those of the rest of the eastern part of Colorado. The amount and distribution of

[6]United States Dryland Field Station, Akron, Colo., is operated by the Division of Dryland Agriculture Investigations of the United States Department of Agriculture, with the Colorado Agricultural Experiment Station cooperating. The cereal experiments were conducted by the Division of Cereal Crops and Diseases, in cooperation with the division named, from 1907 to 1924.

[7]J. F. Brandon, Superintendent of the United States Dryland Station, and D. W. Robertson, Associate Agronomist at the Colorado Experiment Station, carried the work from 1924 to September 1930. J. J. Curtis, Junior Agronomist, Division of Cereal Crops and Diseases, has been in charge of the work since September 1930.

precipitation usually is the limiting factor in crop production, although injury from high temperatures or hail sometimes causes crop losses. Table 5, Appendix, gives the precipitation data for the Akron Field Station for the 8-year period from 1928 to 1935, inclusive. The average annual precipitation for the 8-year period was 16.31 inches, which was below the average for the previous 20-year period of 17.68 inches. The precipitation was above the average for the years 1929, 1930, 1933, and 1935, and below the average for the years 1928, 1931, 1932, and 1934. The precipitation was low during the growing season, April to September, in 1931 and 1934.

Table 6, Appendix, presents the climatic data for the 8-year period 1928 to 1935, inclusive. The evaporation records kept each year from April 1 to September 30 for the years 1928, 1932, 1933, 1934, and 1935 show an increase of 2.709 inches over the average for the 20-year period 1908 to 1927, inclusive. Freezing over of the evaporation tank sometimes makes it impossible to secure complete evaporation records for April.

The records show the average annual wind velocity to be between 6 and 7 miles an hour. The highest monthly velocities usually occur in March, April, and May. During July and August the atmosphere is generally comparatively quiet. Hot winds are almost unknown at Akron. The nights are cool the year 'round. The summer temperatures at Akron usually are mild, due to the elevation, about 4,500 feet above sea level. The average frost-free period is about 142 days.

The latest spring frost at Akron was on June 4, 1919, while for the period of the test, 1928 to 1935, the latest killing frost was on May 22, 1930. The earliest killing frost in the fall was somewhat earlier during this period, the earliest one on record occurring on September 8, 1929. In two years, 1929 and 1930, the season was very short. The lowest precipitation on record was also recorded in this period, 7.45 inches between April and September, inclusive, in 1931. In this year the precipitation was low in April, May, July, August, and September. The year 1934 also showed a low precipitation in the growing season. The precipitation in June was high, but that of April, May, and July was low. July of that year was exceedingly low. The evaporation from a free water surface was considerably above average and, combined with the low rainfall, evidently played an important part in the crop failure of 1934.

Experimental Methods

Soil Preparation

The barleys in the varietal experiments are sown in quadruplicate plats, two on fallow and two on corn land. Data on each variety thus are available on two soil preparations each season.

Preparation of Fallow

The stubble of the previous season's crop remained undisturbed over winter. In the spring it was usually plowed to a depth of from 5 to 7 inches, although in a few seasons this was omitted and the land simply double disked. The soil, however, was always kept free from weeds by the use of a spring-tooth harrow or a duckfoot cultivator. The last cultivation in the fall was done with the duckfoot cultivator to leave the ground rough to catch a maximum of snow and to lessen the chance of soil blowing. The spring-tooth harrow was then used in the spring to level the ground or to break up any crust that had formed during the winter.

Corn land was prepared for barley by cultivation to create a surface seedbed. If the stalks were allowed to remain over the winter period the disk was used to cut up and incorporate the stalks with the soil. In some years the stalks were removed the fall before for forage feed, or for silage, in which case the spring-tooth harrow was usually used in loosening up the surface soil. The corn rows always ran at right angles to the plats later to be seeded to barley.

Four systematically distributed plats were sown to each variety of barley included in the regular plat experiments. The plats used were 8 rods long and 6 feet wide, separated by alleys 16 inches in width. Plats of these dimensions contain one-fifty-fifth of an acre. But, as the plants in them draw considerably on the moisture and plant food in the alleys, it seems fair to consider them as fiftieth-acre plats in computing yields, although their actual area is slightly less. The sowing of four plats at some distance from each other tends to reduce experimental error resulting from soil variation. With less important varieties, sometimes two plats only were sown, one on each soil preparation.

Dates and Rates of Seeding.

From the experiments conducted at the Akron Field Station from 1908 to 1927, inclusive, it appears that the best seeding rate for barley in the section in which the station is located is at least 4 pecks per acre. In general farm practice in the section surrounding the Akron Station the seeding rate is commonly about 4 pecks.

Climatic conditions in eastern Colorado are generally favorable for seeding barley during the period from March 1 to about April 10. It has been conclusively proved that any delay in seeding spring cereals after April 10 is not advisable, as the chances for favorable weather during the ripening period diminish very rapidly as the season advances. The early maturity of barley enables the crop to ripen nearly as early as other spring grains when seeded later. For that reason barley may be seeded after spring wheat. When the farmer has been unable to seed spring wheat during the favorable

seeding period, he can resort to barley and still obtain a reasonable return from his land.

Extremely early seeding is advisable only when soil moisture conditions are favorable, and that course seems advisable in order to keep from having to seed beyond April 10. Seeding in dry ground preferably should be done between March 1 and April 10.

Experimental Results

Of the varieties tested for the entire 8-year period, Club Mariout and Flynn have given the best yields. Several new introductions and hybrids show promise for a shorter period of test. Of these, two white, two-rowed barleys selected from Blackhull, C. I. 878, have shown promise. Vaughn, a six-rowed barley, shows promise. It is, however, slightly later in maturing than Club Mariout. Vance Smyrna, a two-rowed selection from Smyrna, is a high-yielding barley and is smut resistant.

Trebi is not adapted to conditions similar to those found at Akron. California Mariout, C. I. 1455, is not adapted and has been dropped from the test.

A general observation of the growth habit of the various strains which survive under dryland conditions indicates that barleys with a blue-green foliage (Coast) are more likely to be adapted than barleys with a yellow-green foliage such as is found in Trebi and Oderbrucker.

Table 5 presents the yields of four varieties of barley which have been grown at Akron for the 13-year period from 1923 to 1935, inclusive. Club Mariout, C. I. 261, and Flynn, C. I. 1311, have yielded better than Coast, C. I. 690, or Blackhull, C. I. 878.

The yields of the naked barleys, Himalaya and Faust, are low in comparison with the better adapted six-rowed, hulled barleys.

Several varieties which yield well under irrigation have been dropped from the Akron test because of their inability to yield under dryland conditions.

Agronomic Data

The agronomic data are given for seven varieties which have been grown for the entire 8-year period (tab. 6). Club Mariout, Vance Smyrna, and Blackhull mature two or more days earlier than the other varieties. Vance Smyrna has a very short, weak straw under Akron conditions. Club Mariout averages about 24 inches in height, with Flynn only slightly shorter.

The yield of straw and grain is given in table 8, Appendix. There is considerable variability between years, but the average yields, with the exception of Coast and Himalaya, show little difference.

TABLE 5—*Average and annual yield of four varieties of barley grown at Akron for the 13-year period, 1923 to 1935, inclusive*

Variety	C. I. no.	Yield in bushels per acre 1923	1924	1925	1926	1927	1928	1929
Blackhull	878	38.8	6.2	12.1	0.7	28.8	40.7	12.1
Coast	690	26.5	9.1	11.3	1.1	31.4	48.1	9.4
Club Mariout..	261	37.5	8.3	10.5	0.5	33.4	48.2	15.8
Flynn 1311		34.7	9.0	10.0	1.5	31.5	44.2	17.7

Variety	C.I. no.	Yield in bushels per acre 1930	1931	1932	1933	1934	1935	Av.
Blackhull	878	18.6	7.3	9.1	12.0	3.4	40.1	17.7
Coast	690	14.9	11.0	11.5	10.3	4.5	36.0	17.3
Club Mariout..	261	21.8	9.2	12.4	13.6	4.0	38.0	19.5
Flynn 1311		16.9	11.4	12.1	15.8	4.0	38.0	19.0

TABLE 6—*Average agronomic data recorded on seven varieties of barley grown on fallow and on corn land at the United States Dryland Station, Akron, Colo., during the 8-year period from 1928 to 1935, inclusive.*

Group and variety	C. I. no.	Dates First heading	Fully ripe	Height inches	Weight* per bu. pounds	Acre-yield Grain bushels	Straw pounds
2-rowed hulled:							
Blackhull	878	6/6	7/9	21	45.9	17.9	1212
Vance Smyrna ...4585		6/12	7/8	16	45.4	20.0	1203
6-rowed hulled:							
Club Mariout	261	6/7	7/8	24	41.1	20.6	1228
Flynn 1311		6/8	7/10	23	41.1	20.5	1217
Coast	690	6/11	7/11	23	38.4	18.5	1331
Trebi	936	6/17	7/14	22	38.9	13.6	1288
6-rowed hulless:							
Himalaya	620	6/11	7/10	22	53.8	13.8	1104

*Test weights are for the period 1931 to 1935, inclusive.

Fallow Versus Corn Land

The yields obtained from barley grown on fallow and on corn land are given in table 7. Only seven varieties are included in this table. The average bushel yield for all varieties is higher on fallow than on corn land. The difference, however, is greater for the adapted varieties, Club Mariout and Flynn, than for the unadapted varieties, Trebi and Himalaya. The difference of 13.8 bushels for Club Mariout is sufficient to make it desirable to consider fallow as a preparation for barley on the dry land. Earlier tests, Bulletin 371, did not favor fallow as a preparation for barley. However, with the development of better adapted varieties it seems possible that barley may be grown profitably on fallow. Table 7 shows that low yields

TABLE 7—*Annual and average yield of seven barley varieties grown on fallow and on corn land at the Akron Field Station, Akron, Colo., during the 8-year period, 1928 to 1935, inclusive.*

Variety	C. I. no.	Yield in bushels per acre 1928	1929	1930	1931	1932	1933	1934	1935	Total	Average
FALLOW											
Blackhull	878	52.7	17.5	21.4	12.3	14.5	18.5	6.8	46.8	190.5	23.8
Vance Smyrna	4585	56.3	21.9	23.2	17.3	21.7	19.1	7.0	48.0	214.5	26.8
Club Mariout	261	60.9	25.3	24.0	15.1	20.8	21.6	8.0	44.6	220.3	27.5
Flynn	1311	52.6	28.7	21.6	19.8	20.5	24.7	8.0	46.9	222.8	27.9
Coast	690	56.5	14.4	18.3	19.0	18.7	17.5	9.1	43.2	196.7	24.6
Trebi	936	39.8	14.4	11.0	9.3	14.2	10.3	2.0	37.4	138.4	17.3
Himalaya	620	38.8	12.3	16.5	4.2	12.8	14.0	3.9	33.0	135.5	16.9
CORN LAND											
Blackhull	878	28.7	6.6	15.9	2.4	3.7	5.5	0	33.4	96.2	12.0
Vance Smyrna	4585	42.1	5.6	13.3	0.9	2.7	4.9	0	35.7	105.2	13.2
Club Mariout	261	35.4	6.3	19.6	3.3	4.1	5.7	0	34.8	109.2	13.7
Flynn	1311	35.7	6.6	12.3	2.9	3.7	6.9	0	36.4	104.5	13.1
Coast	690	39.7	4.5	11.5	3.1	4.2	3.1	0	33.1	99.2	12.4
Trebi	936	33.8	2.7	10.2	1.2	2.2	1.5	0	27.4	79.0	9.9
Himalaya	620	29.5	4.0	12.8	1.6	2.1	3.1	0	32.7	85.8	10.7

were obtained in 1929, 1931, 1932, and 1933 on corn land. A complete failure was obtained in 1934 on corn land, while about 8 bushels of barley were obtained from the better adapted varieties on fallow.

Summary

Barley is one of the most important spring-sown cereals for dry land in Colorado. Barley outyields oats and often outyields corn in pounds of grain per acre.

At Akron the earlier maturing blue-green foliage types have produced the most favorable yields. Late-maturing varieties as a rule do not yield well under dryland conditions in eastern Colorado. Club Mariout and Flynn are the highest yielding types which have been tested for a period of 8 years or longer. Club Mariout shows considerable natural resistance to smut, but Flynn is susceptible. Both, however, should be treated before seeding.

Vance Smyrna barley, which shows some resistance to smut, is the best-yielding two-row tested for the 8-year period.

Several new introductions show promise. Blackhull Selections 1178 and 1180 are two high-yielding, two-rowed, white barleys. Vaughn, a six-rowed variety, also shows promise. Further tests are necessary, however, before they can be recommended to replace Club Mariout and Flynn. Trebi and California Mariout are not adapted to dryland conditions in eastern Colorado.

The seeding of adapted varieties of barley on fallow may give sufficiently high yields to justify the added expense of fallow. Seed should be sown at the rate of at least 4 pecks per acre.

DESCRIPTION OF BARLEY VARIETIES

Trebi (C. I. 936) is described by Harlan, Martini, and Pope[8] as a pure-line selection made in 1907 in the cooperative breeding experiments conducted by the U. S. Department of Agriculture and the Minnesota Agricultural Experiment Station at St. Paul, Minn. It is a six-rowed, bearded, hulled barley with heads very similar to those of Coast. Under Colorado conditions (irrigated) the kernels are large and bluish in color. The straw is weak. In threshing the awns break off from the glume more easily than do those of the Coast variety.

Colsess[9] (C. I. 2792) is a hooded, six-rowed barley of hybrid origin. It was produced from a cross between Coast and Success. The

[8]Harlan, H. V., Martini, M. L., and Pope, M. M., Tests of Barley Varieties in America, U. S. D. A. Dept. Bul. 1334.

[9]Robertson, D. W., and Kezer, Alvin, Colsess Barley, Colo. Exp. Sta. Bul. 303.

grain is hulled and of a bluish-green color. The straw and glume color is light yellow. The heads are more compact and darker in color than those of Success. The rachis is rather tough, and the head does not shatter easily. The rachilla is covered with short hairs, and the outer glume is hairy. The straw is very stiff. It stands up well under irrigation.

Club Mariout (C. I. 261) is a six-rowed, hulled, and awned barley. The grain is light in color. The awns are stiff, and the head is rather dense. The straw is short. This variety matures early under Colorado conditions. The rachilla has long, straight hairs. Synonym: Mariout.

Flynn (C. I. 1311) is described by Harlan, Martini, and Pope as a six-rowed, smooth-awned hybrid. It came from a cross (Club Mariout x Lion). This barley has shown up well on the Dryland Station at Akron. Its smooth-awned character makes it a desirable barley where the straw is wanted for roughage.

Velvet (C. I. 4252), Reg. No. 4, is a smooth-awned, six-rowed barley. The kernels are rather short and plump under Colorado irrigated conditions. The following statement is made by Harlan[10] regarding its origin:

> In common with all other smooth-awned forms which have been produced in the United States, these varieties owe their smoothness to an original introduction now known as Lion. This smooth-awned parent was first used in the cooperative breeding experiments between the University of Minnesota and the United States Department of Agriculture. The smooth-awned parent used in the cross from which these varieties were originated was a smooth-awned segregate of the Manchuria type from an earlier cross. The F_3 and subsequent generations of the later crosses were grown by the Plant Genetic and Plant Pathology Sections of the Minnesota Agricultural Experiment Station in a special disease nursery at University Farm, St. Paul. The selection of Velvet was made under these conditions.

Wisconsin Pedigree 38[11] is a smooth-awned, six-rowed barley produced at the Wisconsin Experiment Station from a cross between Oderbrucker x Leiorrhynchum, a black, smooth-awned type. The selection Pedigree 38 is resistant to *Helminthosporium gramineum* and resembles Oderbrucker in malting quality. The hybrid selection has a somewhat looser hull than Oderbrucker, which makes threshing without peeling difficult.

[10]Harlan, H. V., Wiggans, R. G., and Newman, L. H., Barley Varieties Registered II, Jour. Amer. Soc. Agron., 20, p. 1,326, 1928.

[11]Shands, R. G., Leith, R. D., Dickson, J. G., and Shands, H. L., Stripe resistance and yield of smooth-awned barley hybrids, Wis. Agr. Exp. Sta. Res. Bul. 116.

APPENDIX

TABLE 1—*Yields of barley varieties grown at Fort Collins for varying periods of years from 1928 to 1935*

Variety	C. I. no.	Yield in bushels per acre 1928	1929	1930	1931	1932	1933	1934	1935	Years grown	Average	Percent Trebi
Trebi	936	81.6	79.0	100.0	76.4	81.2	66.3	78.1	88.5	8	81.4	100.00
Ezond	5064	...	...	102.3	74.3	83.6	56.4	73.8	95.8	6	81.0	99.12
Victory	5077	...	...	104.5	63.3	79.2	59.8	70.2	79.6	6	76.1	93.09
Hannchen	531	74.5	85.3	92.6	65.8	77.8	59.4	67.8	73.8	8	74.6	91.69
Elfry	2800	83.3	66.7	96.8	62.9	73.2	49.6	66.2	72.9	8	71.4	87.79
Colsess	2792	90.5	64.2	90.1	51.7	73.8	45.0	57.5	76.9	8	68.7	84.43
Velvet	4252	71.4	71.3	84.3	58.3	60.4	50.5	64.4	76.8	8	67.2	82.54
Coast No. 23	2791	82.2	65.1	88.8	42.4	67.4	43.3	48.8	60.5	8	62.3	76.56
Nepal	595	50.0	55.5	63.8	45.8	55.8	38.4	52.2	41.2	8	50.3	61.85
Coast x Lion F.C.	1110	...	...	...	...	89.4	57.4	74.9	93.9	4	78.9	100.48
Coast x Lion F.C.	1109	...	...	...	...	84.2	61.5	74.7	85.9	4	76.6	97.56
Coast x Lion F.C.	1108	...	...	...	...	80.9	59.5	67.8	88.1	4	74.1	94.33
Trebi x Colsess F.C.	1124	...	...	...	...	...	66.1	71.3	91.2	3	76.2	98.15
Trebi x Colsess F.C.	1125	...	...	...	...	...	65.9	73.4	87.0	3	75.4	97.17
Trebi x Colsess F.C.	1126	...	...	...	...	...	58.3	61.8	77.6	3	65.9	84.89
Wisc. Pedigree 38	5105	...	...	...	...	...	58.5	63.0	75.6	3	65.7	84.63
New Composite Cross	5461	...	...	...	...	...	45.9	61.4	78.6	3	62.0	79.82
Atlas	4118	...	72.1	107.5	60.2	76.5	42.9	...	...	5	71.8	89.15
Spartan	5027	88.8	66.8	82.4	59.4	81.9	48.9	...	...	6	71.4	88.38
Pearl	5678	...	70.3	94.0	57.7	72.4	53.0	...	...	5	69.5	86.22
Glabron	4577	72.3	74.8	83.6	61.0	75.1	46.9	...	...	6	68.9	85.39
Smooth Awn (dryland)	5673	...	65.0	94.4	60.6	70.8	49.3	...	...	5	68.0	84.41
Comfort	4578	70.0	78.2	84.1	57.4	74.4	43.4	...	...	6	67.9	84.11
Hanna	2784	60.9	80.6	87.7	54.8	68.4	47.0	...	...	6	66.6	82.44
Faust	4579	63.6	51.2	70.3	48.1	65.0	39.3	...	...	6	56.3	69.66
Hero	1286	...	67.4	90.6	45.8	...	...	...	...	3	67.9	79.80
Arequipa	1256	...	67.4	86.3	42.3	...	...	...	...	3	65.3	76.74
Himalaya	620	64.0	47.2	65.9	43.2	...	...	...	...	4	55.1	65.40
Canadian Thorpe	740	77.2	69.5	78.1	...	...	...	...	...	3	74.9	86.26
Club Mariout	261	96.6	59.1	...	...	...	...	...	...	2	77.9	96.95
Lion	923	75.0	77.7	...	...	...	...	...	...	2	76.4	95.08
Moister	2799	82.6	66.4	...	...	...	...	...	...	2	74.5	92.78
Coast	2785	85.7	56.7	...	...	...	...	...	...	2	71.7	89.23
O. A. C. No. 21	1470	75.9	60.4	...	...	...	...	...	...	2	68.2	84.87
Manchuria	2783	65.6	66.2	...	...	...	...	...	...	2	65.9	82.07
Svansota	1907	66.9	56.4	...	...	...	...	...	...	2	61.7	76.77
Telli	194	77.1	...	...	...	...	...	...	...	.	...	....
Silver King	890	73.0	...	...	...	...	...	...	...	.	...	....
Smyrna	2642	65.8	...	...	...	...	...	...	...	.	...	....
Hanna	2787	65.0	...	...	...	...	...	...	...	.	...	....
Charletown 80	2732	46.1	...	...	...	...	...	...	...	.	...	....
Gold	1145	37.6	...	...	...	...	...	...	...	.	...	....
Level of significance	....	8.0	5.0	7.0	7.0	7.0	7.0	9.0	8.0	.	2.5	....

TABLE 2—*Agronomic data on barley varieties grown at Fort Collins for varying periods of years from 1928 to 1935*

Variety	C. I. no.	Date ripe	Days to mature	Straw length	Straw strength	Disease: Helm %	Disease: Smut %	Bushels per acre
Trebi	936	7/22	105	38	M	1.8	0.2	81.4
Ezond	5064	7/21	104	37	M	T	0.3	81.0
Victory	5077	7/24	107	39	M	1.1	0.6	76.1
Hannchen	531	7/24	107	38	M	T	0.4	74.6
Elfry	2800	7/21	104	38	M	2.6	5.9	71.4
Colsess	2792	7/20	103	40	S	3.4	2.1	68.7
Velvet	4252	7/23	106	43	S	7.8	0.1	67.2
Coast No. 23	2791	7/21	104	38	M	10.3	0.6	62.3
Nepal	595	7/21	104	38	W	0.2	1.8	50.3
Coast x Lion F.C.	1110	7/20	102	37	S	5.2	3.9	78.9
Coast x Lion F.C.	1109	7/20	102	37	M	5.6	3.5	76.6
Coast x Lion F.C.	1108	7/21	103	37	S	1.0	1.4	74.1
Trebi x Colsess F.C.	1124	7/21	104	36	S	1.2	0.8	76.2
Trebi x Colsess F.C.	1125	7/24	107	37	S	0.7	0.8	75.4
Trebi x Colsess F.C.	1126	7/23	106	37	M	0.5	1.6	65.9
Wisc. Ped. 38	5105	7/23	106	42	M	T	0.8	65.7
New Composite Cross	5461	7/22	105	38	S	0.3	1.0	62.0

TABLE 3—*Yield of barley varieties at Fort Lewis for varying periods of years from 1928 to 1935,* inclusive*

Variety	C. I. no.	Yield in bushels per acre							Average	Percent Trebi
		1928	1930	1931	1932	1933	1934	1935		
Trebi	936	60.0	94.8	88.7	87.0	80.9	51.0	77.9	77.2	100.00
Coast No. 23	2791	53.3	64.9	84.8	76.8	72.5	60.6	78.5	70.2	90.95
Chevalier II	200	61.3	72.7	85.5	71.3	75.2	55.5	39.5	65.9	85.32
Velvet	4252	49.0	80.8	76.9	79.0	67.8	41.8	58.2	64.8	83.93
Colsess	2792	52.7	73.2	67.9	82.4	61.7	40.1	67.1	63.6	82.38
Nepal	595	43.8	48.7	57.3	65.0	49.0	35.0	44.6	49.1	63.56
Coast x Lion.....F.C.	1110	...	...	...	80.6	68.1	58.7	84.3	72.9	98.28
Ezond	5064	...	...	...	87.2	65.6	45.9	77.4	69.0	93.03
Coast x Lion.....F.C.	1123	...	...	...	...	73.0	70.3	82.7	75.3	107.72
Coast x Lion.....F.C.	1119	...	...	...	...	73.9	59.8	90.7	74.8	106.96
Coast x Lion.....F.C.	1121	...	...	...	...	72.2	66.8	80.1	73.0	104.43
Coast x Lion.....F.C.	1118	...	...	...	...	71.5	69.7	76.2	72.5	103.62
Coast x Lion.....F.C.	1120	...	...	...	...	74.6	58.1	80.8	71.2	101.76
Coast x Lion.....F.C.	1122	...	...	...	...	71.7	59.5	79.1	70.1	100.24
Wisc. Pedigree 38	5105	...	...	...	...	72.2	40.4	69.0	60.5	86.56
Trebi x Colsess	1124	...	...	...	...	...	59.2	78.3	68.8	106.67
Trebi x Colsess	1126	...	...	...	...	...	66.8	63.6	65.2	101.16
Trebi x Colsess	1125	...	...	...	...	...	63.3	57.4	60.4	93.64
Comfort	4578	45.0	64.2	68.5	78.3	71.7	...	...	65.5	79.65
Glabron	4577	45.2	63.3	69.7	81.1	67.8	...	...	65.4	79.51
Spartan	5027	50.5	55.7	72.5	64.3	58.2	...	...	60.2	73.21
Faust	4579	53.9	49.9	61.4	70.8	57.9	...	...	58.8	71.44
Arequipa	1256	...	71.3	92.0	87.4	60.8	...	...	77.9	88.65
Himalaya	620	26.1	27.1	...	...	...	...	...	26.6	34.37
Elfry	2800	43.6	...	...	...	...	...	...	...	72.67
Moister	2799	42.3	...	...	...	...	...	...	...	70.50
Level of significance	....	10.0	11.0	10.0	12.0	10.0	12.0	8.0	4.0	....

*In 1929 hail destroyed crop before harvest.

TABLE 4—*Agronomic data on barley varieties grown at Fort Lewis substation for varying periods of years from 1928 to 1935, inclusive*

Variety	C. I. no.	Date ripe	Days to mature	Straw length	Straw strength percent	Years grown no.	Bushels per acre
Trebi	936	8/4	105	33	64	7	77.2
Coast No. 23	2791	8/5	104	32	62	7	70.2
Chevalier II	200	8/13	112	34	42	7	65.9
Velvet	4252	8/4	105	35	47	7	64.8
Colsess	2792	8/5	104	33	91	7	63.6
Nepal	595	8/8	107	32	70	7	49.1
Coast x Lion.....F.C.	1110	8/5	101	33	86	4	72.9
Ezond	5064	8/5	102	33	71	4	69.0
Coast x Lion.....F.C.	1123	8/7	106	33	66	3	75.3
Coast x Lion.....F.C.	1119	8/6	105	32	67	3	74.8
Coast x Lion.....F.C.	1121	8/5	104	31	70	3	73.0
Coast x Lion.....F.C.	1118	8/9	108	31	58	3	72.5
Coast x Lion.....F.C.	1120	8/5	104	32	70	3	71.2
Coast x Lion.....F.C.	1122	8/5	104	32	71	3	70.1
Wisconsin Pedigree 38...	5105	8/9	108	35	85	3	60.5
Trebi x Colsess.....F.C.	1124	8/5	105	33	80	2	68.8
Trebi x Colsess.....F.C.	1126	8/9	109	35	84	2	65.2
Trebi x Colsess.....F.C.	1125	8/9	109	33	88	2	60.4

TABLE 5—*Monthly, annual, seasonal, average monthly, average annual, and average seasonal precipitation at the U. S. Experiment Station, Akron, Colo., during the period 1928 to 1935, inclusive*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Seasonal April-Sept.	Annual
1928	.13	.17	.32	.17	3.52	5.39	3.14	.25	.04	1.75	.49	T	12.51	15.37
1929	.07	.34	.32	3.43	1.19	1.15	4.44	2.66	2.67	2.76	.49	.09	15.54	19.61
1930	.07	T	.17	2.28	5.52	1.61	3.54	3.48	.39	.83	1.05	.09	16.82	19.03
1931	.01	.71	.95	.84	1.38	2.20	1.49	1.04	.50	.61	.11	.90	7.45	10.74
1932	.27	.25	.60	1.93	2.91	2.80	4.17	1.27	.05	.49	.19	.21	13.13	15.14
1933	T	.04	.74	4.58	4.15	.92	2.01	4.54	1.13	T	.04	.75	17.33	18.90
1934	.02	.91	.36	.64	1.42	4.14	.31	3.56	.75	.04	.37	.09	10.82	12.61
1935	.01	.23	1.22	3.25	7.35	3.08	.37	.83	2.24	.21	.26	.04	17.12	19.09
Average	.07	.33	.59	2.14	3.43	2.66	2.43	2.20	.97	.84	.38	.27	13.84	16.31
20-year average, 1908-1927	.34	.47	.86	2.25	2.66	2.26	2.65	2.24	1.58	1.06	.57	.74	13.63	17.68

TABLE 6—*Seasonal and average seasonal precipitation, evaporation, date of last spring, and first fall frosts, and length of the frost-free period at U. S. Experiment Station, Akron, Colo., from 1928 to 1935, inclusive*

Year	Seasonal (Apr.-Sept., incl.) Precipitation	Seasonal (Apr.-Sept., incl.) Evaporation	May-Sept. Evaporation	Frost dates: Last spring	Frost dates: First fall	Days in frost-free period
1928	12.51	43.161	37.930	April 26	Sept. 20	147
1929	15.54	.....	36.501	May 5	Sept. 8	126
1930	16.82	.....	35.348	May 22	Sept. 25	126
1931	7.45	.....	42.505	May 21	Oct. 13	145
1932	13.13	49.147	43.398	April 29	Oct. 3	157
1933	17.33	44.831	39.281	May 10	Oct. 7	150
1934	10.82	52.619	46.948	April 26	Sept. 14	141
1935	17.12	40.563	36.315	May 4	Sept. 26	145
Average	13.84	46.064	39.778	May 7	Sept. 26	142
Average, 1908-1927	13.63	43.355	38.412	May 11	Sept. 29	141

TABLE 7—*Annual and average yield of 25 barley varieties or strains grown at the Akron Field Station during the 8-year period 1928 to 1935, inclusive*

Variety	C. I. no.	Yield in bushels per acre: 1928	1929	1930	1931	1932	1933	1934	1935	Years grown	Average	Yield in percent of Club Mariout
Two-rowed hulled												
Blackhull	878	40.7	12.1	18.6	7.3	9.1	12.0	3.4	40.1	8	17.9	86.9
Vance Smyrna	4585	49.2	13.7	18.2	9.1	12.2	12.0	3.5	41.9	8	20.0	97.1
Pryor	2359	...	...	...	10.0	9.0	13.0	3.5	36.9	5	14.5	91.8
Blackhull Sel. 1178	5679	...	...	...	13.3	12.2	13.2	3.1	41.9	5	16.7	106.1
Blackhull Sel. 1180	6009	...	...	...	...	16.0	15.2	4.4	37.7	4	18.3	105.2
Smyrna	2642	41.9	11.4	13.2	...	...	...	...	...	3	22.2	77.6
White Smyrna (Sel. 09WS)	4584	45.5	12.4	16.4	...	...	...	...	...	3	24.8	86.7
Horn	926	...	...	...	4.9	9.5	...	...	...	2	7.2	66.7
Six-rowed hulled												
Trebi	936	36.8	8.6	10.6	5.2	8.2	5.9	1.0	32.4	8	13.6	66.0
Coast	690	48.1	9.4	14.9	11.0	11.5	10.3	4.5	38.1	8	18.5	89.8
Club Mariout	261	48.2	15.8	21.8	9.2	12.4	13.6	4.0	39.7	8	20.6	100.0
Flynn	1311	44.2	17.7	16.9	11.4	12.1	15.8	4.0	41.6	8	20.5	99.5
Moister	2799	49.1	12.3	19.7	10.7	8.1	12.0	1.6	35.3	8	18.6	90.3
Vaughn	1367	...	...	...	12.3	9.9	14.9	4.2	43.1	5	16.9	107.0
Stavropol (Kans. Sel. No. 30752)	5921	...	...	...	...	...	10.5	4.7	33.9	3	16.4	85.7
Pearl	5678	...	...	16.4	7.2	8.6	5.1	1.6	...	5	7.8	63.8
Arequipa	1256	44.4	15.3	15.8	9.6	11.8	...	...	...	5	19.4	90.7
Comfort	4578	47.8	13.0	15.9	8.1	...	...	...	...	4	21.2	89.1
Malt	5677	...	11.3	14.2	9.3	10.0	...	...	...	4	11.2	75.7
Glabron	4577	44.1	6.4	13.8	3.0	...	...	...	...	4	16.8	70.6
Colsess	2792	38.1	10.8	10.7	...	...	...	...	...	3	19.9	69.6
Elfry	2800	46.4	13.2	18.2	...	...	...	...	...	3	25.9	90.6
California Mariout	1455	30.8	...	...	...	...	...	...	...	1	30.8	63.9
Coast x Lion	F.C. 1110	...	...	...	...	...	...	...	33.3	1	33.3	83.9
Six-rowed hulless												
Himalaya	620	34.2	8.1	14.6	2.8	7.4	8.5	2.0	32.8	8	13.8	67.0
Faust	4579	33.2	6.5	10.6	2.9	7.5	...	...	...	5	12.1	56.3

TABLE 8—*Annual and average yield of grain and straw for seven varieties of barley grown on fallow and on corn land for the 8-year period 1928 to 1935, inclusive, at the Akron Field Station*

Variety	C. I. no.	1928	1929	1930	1931	1932	1933	1934	1935	8-year average
		STRAW YIELDS IN POUNDS PER ACRE								
Blackhull	878	2410	918	1213	463	439	1028	550	2676	1212
Vance Smyrna	4585	3008	625	963	520	449	840	434	2786	1203
Club Mariout	261	2465	825	1144	503	534	935	553	2864	1228
Flynn	1311	2369	920	981	663	512	999	553	2740	1217
Coast	690	3209	893	881	719	544	900	471	3028	1331
Trebi	936	3312	628	1038	495	584	684	340	3221	1288
Himalaya	620	3049	598	1150	276	511	731	331	2183	1104

Variety	C. I. no.	1928	1929	1930	1931	1932	1933	1934	1935	8-year average
		GRAIN YIELD IN BUSHELS PER ACRE								
Blackhull	878	40.7	12.1	18.6	7.3	9.1	12.0	3.4	40.1	17.9
Vance Smyrna	4585	49.2	13.7	18.2	9.1	12.2	12.0	3.5	41.9	20.0
Club Mariout	261	48.2	15.8	21.8	9.2	12.4	13.6	4.0	39.7	20.6
Flynn	1311	44.2	17.7	16.9	11.4	12.1	15.8	4.0	41.6	20.5
Coast	690	48.1	9.4	14.9	11.0	11.5	10.3	4.5	38.1	18.5
Trebi	936	36.8	8.6	10.6	5.2	8.2	5.9	1.0	32.4	13.6
Himalaya	620	34.2	8.1	14.6	2.8	7.4	8.5	2.0	32.8	13.8

END OF
TITLE